NON-PUBLIC?: N
ACCESSION #: 9507240021
LICENSEE EVENT REPORT (LER)

FACILITY NAME: Seabrook Station PAGE: 1 OF 5

DOCKET NUMBER: 05000443

TITLE: Manual Reactor Trip due to Loss of Turbine Electro-
hydraulic Control Pumps
EVENT DATE: 06/18/95 LER #: 95-02-00 REPORT DATE: 07/18/95

OTHER FACILITIES INVOLVED: DOCKET NO: 05000

OPERATING MODE: 1 POWER LEVEL: 100

THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR SECTION:
50.73(a)(2)(iv)

LICENSEE CONTACT FOR THIS LER:
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COMPONENT FAILURE DESCRIPTION:
CAUSE: SYSTEM: COMPONENT: MANUFACTURER:
REPORTABLE NPRDS: YES

SUPPLEMENTAL REPORT EXPECTED: NO

ABSTRACT:

On June 18, 1995 at 1827 a manual reactor trip was initiated from 100% power. The reactor AB! was manually tripped after power was lost to both turbine electro-hydraulic control (EHC) TG! pumps. This event was reported to the NRC pursuant to 10 CFR50.72(b)(2)(ii), actuation of the Reactor Protection System (RPS) and Engineered Safety Feature (ESF) system. There were no adverse safety consequences as a result of this event.

Prior to the reactor trip, Unit Substation US-14 EA! was cross-tied to Unit Substation US-21 to restore power to two motor control centers, after the primary feeder breaker on US-21 tripped open due to a ground caused by a failed surge arrester. The US-14 transformer tripped, while cross-tied to US-21, due to an unrelated end-of-life fault (primary to

secondary) on the US-14 13.8 kV non-safety related transformer. This resulted in the loss of power to the EHC pumps. The loss of power to buses US-14 and US-21 complicated the secondary plant trip response.

The root cause of this event was determined to be an inadequate design for the 13.8 kV non-safety related transformer.

North Atlantic has taken actions to correct the transformer and surge arrester conditions. These include replacing trip critical 13.8 kV non-safety related transformers, developing further guidance regarding cross-tying electrical buses and replacing surge arresters.

END OF ABSTRACT

Description of Event

At 1451 on June 18, 1995, with the unit operating at 100% power, a loss of non-vital, 480V bus US-21 ED! occurred when a surge arrester on the 13.8 kV non-safety related feeder line to the bus transformer failed, creating a ground. At 1544, in order to restore power to the affected equipment, bus 21 was cross-tied to non-vital, 480V bus US-14. At 1826, the bus US-14 feeder breaker tripped open due to a transformer failure that was not related to the surge arrester failure on US-21. With both buses deenergized, power was lost to both turbine electro-hydraulic (EHC) pumps. In response, operators manually tripped the reactor and entered E-0, "Reactor Trip or Safety Injection" and quickly transitioned to ES 0.1, "Reactor Trip Response". At 1834, the main steam isolation valves were closed based on decreasing Tavg. As expected, a feedwater isolation on Low Tave-Reactor Trip and an emergency feedwater BA! actuation on Low Steam Generator Level occurred following the manual reactor trip.

The loss of power to buses US-14 and US-21 complicated the plant trip response. Manual action was required to close the high pressure steam supply motor operated valves (MOVs) to the moisture separator reheater (MSR) SN!, due to a loss of power to the MOV actuators. The reheater drain tank (RHDT) normal level control valves failed closed. The A, B, and C RHDT high level dump valves failed open. The D RHDT flooded because its high level dump valve was stuck closed. Heater Drain SN! Pump A did not automatically trip due to loss of control power and had to be manually tripped. In addition, other secondary plant equipment, including the Demineralized Water System KC! and portions of the Water Treatment KH! System, were without power.

At 1852, the feedwater isolation valves were opened in preparation for

the switchover from emergency feedwater (EFW) to the startup feed pump (SUFP) as the source of makeup to the steam generators AB!. Shortly after flow was shifted to the SUFP, a leak developed in the 26A high pressure feedwater heater SJ!. A high differential temperature across the 26A feedwater heater caused tubesheet deflection, which resulted in three tubes being pulled out of the tubesheet.

In order to terminate the transfer of condensate to the hotwells and preserve Condensate Storage Tank (CST) BA! inventory, the SUFP suction was realigned from the CST to the Condensate Cleanup System KD! per operating procedure OS 1000.11, "Post Trip to Hot Standby". Several difficulties occurred during this evolution that resulted in a continued decrease in CST inventory. At 2001, the pressure sensing line for the differential pressure cell across the condensate filters ruptured resulting in a loss of differential pressure indication. Due to filter clogging, a high filter differential pressure was created across the condensate cleanup filter. This caused the pressure control valve for the Condensate Cleanup System to fully open and consequently cause the downstream condensate relief valve to lift.

The condensate relief valve lift resulted in loss of approximately 80,000 gallons of hotwell and CST inventory to the turbine building sump TF!. Without the indication of the filter differential pressure, operators believed that the relief valve lift was the result of a malfunction of the Condensate Cleanup System pressure control valve and that the differential pressure across the filter was normal. They did not, therefore, consider realigning the system to direct flow through the redundant filter bank. Because of the degraded flow, the SUFP suction was swapped back (at about 2025) to the CST. At 2038, the SUFP low suction trip was bypassed because of a concern for tripping the pump.

At this time, there was no makeup to the CST since there was no power to the demineralized water transfer pumps and portions of the Water Treatment System.

At 2055, because of concern for the SUFP net positive suction head, the CST low suction tap was opened. This connection is normally isolated to prevent loss of the Technical Specification dedicated water volume. Efforts were underway to repair the Condensate Cleanup System and provide makeup to the CST.

At 2113, bus US-14 was cross-tied to bus US-16 to restore power to the balance of plant equipment. At 2140, Technical Specification Action Statement 3.7.1.3 was entered when CST level reached the Technical

Specification low limit. At 2200, with power restored to bus US-14, operators commenced filling the CST from the Demineralized Water System. Operators also opened the normally-closed condensate reject valve. This valve is kept closed to preclude problems with water chemistry in the CST. This allowed the condensate pumps to route water from the hotwell back to the CST, and the CST level increased above the Technical Specification low limit.

Approximately five minutes after the condensate reject valve was opened, the 26A feedwater heater shell side relief valve opened in response to an increasing shell side pressure. This pressure increase was caused by the tube leaks in the 26A feedwater heater and the re-energization of the heater drain tank level control circuit. The re-energization caused the 26A feedwater high level dump valve to close (d
e to a high-high level
condition in the heater drain tank). The shell side of the heater quickly went water solid, causing the shell side relief valve to lift.

Control room personnel focused on separating the balance of plant equipment from the safety related EFW System. The motor-driven EFW pump was restarted at 2234, and the SUFP was shutdown at 2248.

At the time of the transfer from the SUFP to EFW pump, the 26A feedwater heater tube leak was undetected. Shutdown of the SUFP allowed depressurization of the feedwater header and the tube side of the 26A and 26B high pressure heaters. This depressurization resulted in a significant thermal hydraulic transient about 15 minutes after shutdown of the SUFP. The thermal hydraulic transient was eliminated by restoring flow through the feedwater heaters by opening a recirculation flowpath from a condensate pump to the condenser.

After the Condensate Cleanup System was repaired, the SUFP was realigned at 0244 to feed the steam generators. Feedwater conditions were erratic and feedwater header pressure was lower than normal. At approximately 0430, operators noted unusual noises coming from the 26A feedwater heater. This led operators to suspect the heater tube leak. Operators then isolated the 26A feedwater heater, and feedwater header pressure returned to normal.

Prior Events

This is the second event at Seabrook Station when a reactor trip occurred while bus US-14 was cross-tied to bus US-21 (see LER 91-001). In the 1991 event, an automatic turbine trip and reactor trip was initiated by a loss of EHC pressure when the breaker for US-21 tripped due to two large cyclical loads being energized simultaneously while the buses were

cross-tied. The cyclical loads were not energized during the July 18, 1995 event.

Root Cause

The primary root cause of the transformer US-14 trip, while cross-connected to US-21 was due to an end-of-life fault (primary to secondary) from an inadequate transformer design. This caused the loss of electrical power to the EHC pumps and in response, operators manually tripped the reactor.

The investigation and analyses of the 13.8 kV non-safety related transformer has determined that the design of these transformers did not preclude an aging property known as partial arc discharge. This property was detected in failed transformers, in-service transformers, and spare transformers. The effect of partial arc discharge is accelerated degradation of the winding insulation to the point that the transformer shorts due to phase-to-phase fault or flashes over to ground. The US-21 transformer had been in service for more than 10 years at the time of its failure. A second transformer failed during subsequent troubleshooting of the surge arrester when it was re-energized. It was determined through analysis and work with the vendors that re-energization of these transformers yields high stresses that are conducive to primary to secondary failure.

In addition, the 13.8 kV non-safety related transformers were originally designed to have a higher temperature rise (150 degrees C vs the new recommendation of 80 degrees C). As a result, they were operated at higher temperatures and were subject to thermal aging effects. This accelerated the effects of partial arc discharge.

Contributing Factor

A contributing factor to this event was determined to be the degraded surge arrester in US-21. This resulted in the tripping of the US-21 substation and lead to the cross-tie with US-14. When bus US-14 tripped, the cross-tie configuration required the plant trip due to the loss of power to the EHC pumps.

The failure of the surge arrester was determined to be a service life related failure most likely related to the loss of the nitrogen gas. The loss of nitrogen gas was caused by a broken seal. The loss of nitrogen allowed the ingress o moisture which was absorbed into the internal dessicant which became saturated and was no longer effective.

Safety Consequences

There were no adverse safety consequences as a result of this event. Plant equipment functioned as designed, with one exception. The MSR RHDT D high level dump valve should have failed open on loss of power (powered from bus US-21), but was stuck in the closed position, causing the tank to flood shortly after the turbine trip. Operator action were reviewed and determined to be correct. This conclusion was made considering the equipment that was no available due to the loss of electrical buses US-14 and US-21. At no time during the event was there any adverse affect on the health and safety of the plant employees or the public.

Corrective Actions

In response to this event, North Atlantic conducted an event evaluation and root cause analysis. Several corrective actions were recommended as part of the event evaluation to prevent future occurrences and to improve the plant and procedural response to such complicated events. These corrective actions include but are not limited to the following:

1. The failed 13.8 kV non-safety related transformer and selected other 13.8 kV non-safety related transformers that were determined to be critical to plant operation and/or response to plant transients were replaced with new transformers.

2. One safety related 4160 volt transformer was removed from service for destructive testing and inspection and replaced with a new transformer. The results of the inspection and testing of the in-service safety related 4160 volt transformer found no degradation of the turn or layer-to-layer insulation.

3. The surge arresters on the critical non-safety related 13.8 kV buses were replaced with a new design surge arrester.

4. The secondary plant was restored to operational status with the 26A and 26B feedwater heaters isolated.

5. Similar transformers and surge arresters will be evaluated to determine if similar failure mechanisms are applicable and if the transformers and surge arresters should be replaced.

6. The appropriate operating procedures will be reviewed and revised to provide enhanced guidance for cross-tying electrical buses and for

maintaining CST inventory during complex plant transients in addition to that provided prior to restart of the unit.

Plant Conditions

At the time of this event, the plant was in Mode 1, at 100 percent power, with a Reactor Coolant System temperature of 587 degrees Fahrenheit and a pressure of 2235 psig.

North
Atlantic

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The Northeast Utilities System

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July 18, 1995

United States Nuclear Regulatory Commission
Washington, D.C. 20555

Attention: Document Control Desk

Reference: Facility Operating License No. NPF-86, Docket No. 50-443

Subject: Licensee Event Report (LER) No. 95-02-00: "Manual Reactor Trip due to Loss of Turbine Electro-hydraulic Control Pumps"

Gentlemen:

Enclosed please find Licensee Event Report (LER) No. 95-02-00 for Seabrook Station. This submittal documents an event which occurred on June 18, 1995. This event is being reported pursuant to 10CFR50.73(a)(2)(iv).

Should you require further information regarding this matter, please contact Mr. James M. Peschel, Regulatory Compliance Manager, at (603) 474-9521, extension 3772.

Very truly yours,

Ted C. Feigenbaum

TCF:JMPjr/act

Enclosures: NRC Forms 366/366A

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